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ON-SITE DISPOSAL FACILITY BORROW AREA STRATEGY REPORT

SOIL AND DISPOSAL FACILITY PROJECT

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

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U.S. DEPARTMENT OF ENERGY
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REVISION B

EXECUTIVE SUMMARY

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This report presents the updated strategy for developing, managing, and restoring the On-Site Disposal Facility (OSDF) borrow area. This updated strategy is based on information obtained during borrow activities associated with construction of clay liners and other components of OSDF Cells 1 through 3 and a revised estimate of the OSDF maximum size from nine to seven cells. This information and the revised size affect the required estimated required quantity of borrow material.

In this report, the required borrow material quantities are estimated based on the OSDF design with seven cells. The major borrow material quantities include: clay material, ordinary borrow material, and topsoil. Borrow material sources were identified based on geotechnical investigations conducted during the initial design phase. The geotechnical investigations were used to characterize the material; estimate shrinkage/bulking and other factors; and determine available quantities of different materials (clay, silt, sand, etc.). In the initial design, the primary source for borrow material was proposed to be the brown till from the east side of the east field borrow area (EFBA). The west side of the EFBA was reserved as a contingency borrow area. The brown till is a clay material overlying a gray till stratum. A test pad program was performed that demonstrated the suitability of the brown till for use as clay material in the OSDF clay liner and cover system. Therefore, only the brown till was, and will be, used as clay material.

The clay liners for OSDF Cells 1, 2 and 3 were constructed during 1997-99 construction seasons. Clay material for the clay liner in Cell 1 and approximately 25 percent of the clay material in the Cell 2 liner was obtained from excavation in the OSDF footprint area. The remainder of the clay material for the Cell 2 and for Cell 3 liner was obtained from the east side of the EFBA. During initial Cell 1 borrow activities, more rock particles were encountered in the clay material than expected; these rocks were initially picked and removed by hand. However, this was inefficient and led to safety concerns. Therefore, during the remainder of Cell 1 and during Cell 2 and 3 liner construction, screening was used to remove the rock to conform to project requirements and improve the quality of the clay material. Screening of clay material generated reject material. Also, when clay material was excavated, more unsuitable material (material with high levels of organic material, sand, and silt and material that did not conform to clay material technical specifications) was encountered than expected. Because of these conditions, the overall volume of borrow excavation needed to provide the required quantities of clay material increased.

In accordance with the updated borrow area strategy presented in this report, the required borrow material volume is proposed to be obtained from the east side of the EFBA. Brown till will be used for the OSDF liners and caps. Whenever possible, brown till will be excavated, processed, and stockpiled the year before it is scheduled for use in constructing an OSDF cell. Both brown and gray till will be used for ordinary borrow material. This report also presents a contingency plan to expand the borrow area horizontally to the northeast if additional material is required.

This updated strategy is based on an evaluation of existing field data and required borrow material quantity estimates, which are presented in this report. This report also outlines the incremental restoration strategy planned for the borrow area.

The initial requirements and specific criteria for borrow area development and management were presented in the Borrow Area Management and Restoration (BAM&R) Plan and the OSDF Final Design Package, and OSDF Phase I and Phase II Certified-for-Construction (CFC) packages). This report will serve as a basis to update the BAM&R Plan and as a guide for future borrow activities, including preparing the OSDF Phase III CFC package.

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LIST OF ACRONYMS AND ABBREVIATIONS

BAM&R	Borrow Area Management and Restoration
bcy	bank cubic yard
CFC	Certified for Construction
EFBA	East Field Borrow Area
FEMP	Fernald Environmental Management Project
FRL	Final remediation level
ft	Feet
GMA	Great Miami Aquifer
icy	in-place cubic yard
OSDF	On-Site Disposal Facility
OU	Operable Unit
RI/FS	Remedial Investigation/Feasibility Study
SER	South Entrance Road

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GLOSSARY

Bank Cubic Yard (bcy) - A cubic yard of in-situ material in a natural condition. -- 2642

Cell - One of the discrete disposal enclosures in the OSDF.

Clay material – Brown till material that meets the technical specification and performance requirements for clay liner (including intercell berm and clay wedge) and clay cap.

Fill Material – Brown or gray till material that will be used to construct the OSDF earthwork components, excluding the clay liner and clay cap.

Final Restoration – Final restoration in the borrow area consists of planting trees and final vegetation.

In-Place Cubic Yard (icy) – A cubic yard of material that is placed and compacted.

Interim Restoration – Interim restoration in the borrow area consists of final grading and establishing grass vegetation after borrow excavation is completed in each discrete subarea.

Liner Subgrade - Material located directly below the clay liner of the OSDF

Ordinary Borrow – Brown and/or gray till material suitable for fill material (including compacted fill, vegetative soil cover, and miscellaneous fill) that meets requirements in the technical specifications, excluding topsoil.

Reject Material - Material generated during the clay material screening process that does not pass through the screens. Consists primarily of soil clods and rock particles.

Screener Reject Factor- Percent of the volume of material that is "rejected" during the clay screening process. Volume of material that does not pass through the screens divided by the total volume of material placed on the screens.

Shrinkage/Bulking Factor – Percent of the total volume of bank cubic yards (bcy) in the borrow area compared to in-place cubic yards (icy) in the OSDF.

Soil Factors – Percentages of material excavated (bcy) that impacts in-place volume (icy). Soil factors include: shrinkage/bulking, screener reject, unsuitable material, and wastage.

Subarea – Discrete area within the borrow area that will be developed during one construction season.

Unsuitable Material – Unsuitable material is material that does not meet the requirements for clay material listed in the technical specifications. This material includes soils with high silt, sand and/or gravel content, material with high organic material or other material that is not suitable for processing as clay material. Unsuitable material may be used as ordinary borrow material if it meets the requirements in the technical specifications for fill material.

Unsuitable Soil Factor – Percent of the total volume of material excavated in the borrow area that is not suitable for processing for clay material.

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Wastage Factor – Percent of the total volume of material excavated from the borrow area that will be wasted and will not be used for any fill or clay material.

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1.0 INTRODUCTION

Borrow material is required for constructing the On-Site Disposal Facility (OSDF) at the Fernald Environmental Management Project (FEMP). Initial borrow material estimates and a borrow area excavation strategy were prepared during the initial OSDF design and implemented during the first three construction seasons in 1997, 1998 and 1999. During these first three construction seasons, actual field data have been obtained to verify, evaluate, and update the initial estimates. This report presents updated borrow material estimates for construction of liners for four cells and caps for seven cells, and includes estimates for the revised borrow material quantities, analysis of the field data obtained from the first three construction seasons, a summary of existing borrow area conditions, and an updated strategy to develop and restore the borrow area.

1.1 OBJECTIVE

The objective of this report is to evaluate the borrow area based on updated borrow quantity estimates and to present the strategy to develop, manage and restore the borrow area. This report will be used as a basis for updating the Borrow Area Management and Restoration (BAM&R) Plan and preparing the OSDF Phase III Certified-for-Construction (CFC) package for the remaining components.

1.2 GENERAL BORROW AREA STRATEGY

Borrow volume estimates for the remaining OSDF construction presented in this report are based on the types of borrow required for the remaining four clay liners and seven clay caps, the geotechnical analyses of on-site sources of the borrow, and field data obtained during construction. The three general types of required borrow material include:

- Clay material
- Ordinary borrow material
- Topsoil

Clay material is needed for the clay liner and clay cap for each OSDF cell. The clay liner includes the material for the liner and the associated intercell berm and clay wedge.

Whenever possible, clay material will be excavated, processed and stockpiled one year prior to its placement in the OSDF. This will ensure that clay material is available at the start of the construction season. This will minimize potential delays and ensure complete construction of a cell cap in one

construction season. Clay material will be required early in the OSDF cap construction process to allow subsequent time for placement of additional layers (biointrusion barrier, vegetative layer, etc.) later in the same construction season. It will reduce impacts from adverse weather conditions; this will be critical during the years when both a clay liner and cap will be built. Stockpiling a year ahead of time will also provide time to adjust if significant quantities of unsuitable material are encountered and the subarea must be expanded to obtain the needed material quantities.

The OSDF Test Pad Program demonstrated that the brown till is suitable for clay material in the OSDF if it meets the material and performance requirements in the technical specifications. During excavation for clay material, "unsuitable" material will be encountered that cannot meet the material and performance requirements of the technical specifications and will not be suitable for use as clay material. "Unsuitable" material may be used for ordinary borrow and/or topsoil if it meets the material requirements in the technical specifications.

Ordinary borrow material will be needed to backfill overexcavation of unsuitable subgrade, construct berms at the perimeter of the OSDF cells, and provide vegetative soil cover, fill for roads, and other miscellaneous fill. This material must meet the requirements of the technical specifications for fill material. Ordinary borrow includes unsuitable clay material that can be placed as compacted fill and vegetative soil cover and may consist of either brown or gray till.

Topsoil from the borrow area will be used in the construction of the caps (covers) for the OSDF. Topsoil will be stripped and stockpiled before excavating a new subarea in the borrow area and from the OSDF construction area.

During initial OSDF design development, screening of clay material was not considered. However, screening of clay material was added during construction of the clay liner for Cell 1 to remove rock particles larger than two inches so the material would meet the technical specification requirements for the compacted clay liner and caps. Screening was subsequently specified (and used) as a requirement in the technical specifications for Cells 2 and 3 and will be specified for future cells. Screening of clay material during liner construction generated a considerable volume of reject material and, as a result, required excavation of additional borrow material volume to obtain the necessary clay quantities. Unsuitable material was also encountered during excavation. Borrow volume estimates for reject material and large quantities of unsuitable material were not included in the original estimates because

screening was not specified. Updated borrow volume estimates, reject and unsuitable material estimates are presented in this report and incorporated into the borrow area excavation and restoration strategy.

During construction of the first three cells, the majority of the required ordinary borrow material was obtained from the OSDF footprint area; the remainder was obtained from the OSDF borrow area. However, in the future, it is anticipated that ordinary borrow material will be obtained from the OSDF borrow area. This report is based on obtaining all required borrow material from the OSDF borrow area on the east side of the EFBA.

1.3 REPORT ORGANIZATION

Section 1 presents an introduction and overview of this report.

Section 2 summarizes existing conditions in the east side of the EFBA. This includes a description of the physical constraints in the area and the locations of the brown and gray till stratums.

Section 3 summarizes the estimated quantities of material required from the borrow area. This includes both estimated bank (in the borrow area) and in-place (in the OSDF) cubic yards as well as the factors that relate these two quantities.

Section 4 presents the conceptual borrow area development plan and the criteria that were used to develop the plan.

Section 5 presents restoration concept for the OSDF borrow area.

References are provided at the end of the report. Appendix A contains figures that present background and general information about the borrow area as well as conceptual excavation and restoration plans. Appendix B presents calculations, including volume estimates and field data from three previous construction seasons, as well as the basis for estimating the soil factors.

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2.0 EXISTING CONDITIONS

The east side of the EFBA will be used as the source of borrow material for the OSDF. A geotechnical investigation of the area was performed during the Operable Unit (OU) 2 Remedial Investigation/ Feasibility Study (RI/FS) and the OSDF pre-design investigation.

The east side of the EFBA is located in the southeast corner of the FEMP, as shown on Figure 2-1. It is bounded by the South Entrance Road (SER) to the west, the aesthetic barrier and Willey Road to the south, the Mid-Valley pipeline (and right-of-way) to the east, and the OSDF Borrow Area Sedimentation Basin to the northwest. The EFBA Borrow Area is not physically constrained to the northeast; therefore, the area northeast of the borrow area and northeast of the OSDF Borrow Area Sedimentation Basin is identified as a contingency borrow area. Existing EFBA conditions (as of November 1999) are shown on Figure A-1 in Appendix A.

2.1 BACKGROUND INFORMATION

The EFBA was not disturbed by US Department of Energy (DOE) material production operations. Except for the Trap Range, the area has been certified as below final remediation levels (FRLs). The Trap Range is expected to be certified to below FRLs by February 2000. Prior to recent construction activities (OSDF Borrow Area Sedimentation Basin construction, borrow excavation, Trap Range stabilization and excavation, etc), the surface of the EFBA was covered with topsoil. The areas that have not been disturbed remain covered with topsoil. Generally, the subsurface material immediately below the topsoil consists of brown till to a depth of 10 to 20 feet. A gray till stratum is located below the brown till; the gray till ranges in thickness from 10 to 20 feet. The sand and gravel of the Great Miami Aquifer (GMA) are located beneath the gray till stratum.

The brown till was determined to be suitable for clay material during the OSDF test pad program. The gray till was not evaluated during the test pad program and therefore will not be used for clay material; only brown till will be used as clay material. Both brown and gray till will be used for ordinary borrow material.

During OSDF design, DOE made a commitment to the stakeholders that a minimum of 12 feet of gray till will be maintained below the OSDF. Although this commitment does not apply to other areas of the FEMP, the borrow excavation concept presented in this report maintains a minimum of 12 feet of gray till in the borrow area. No borrow area excavation will be performed in areas where the gray till is less

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than 15 feet thick. The thickness of the gray till stratum and proposed excavation depths are shown on Figure A-4 in Appendix A.

Clay material for the Cell 1 clay liner and approximately 25 percent of the material for the Cell 2 clay liner were obtained from the OSDF footprint area. During construction of the liner systems for Cells 1, 2 and 3, ordinary borrow was also obtained from excavation in the OSDF footprint area. Also, very little unsuitable subgrade material was encountered; therefore, no borrow was needed to backfill unsuitable subgrade excavations. The east side of the EFBA was used to obtain clay liner material for Cells 2 and 3.

The strategy presented in this report is based on obtaining all required borrow material to construct the remaining four liners, seven caps, and assorted components for the remainder of the OSDF from the east side of the EFBA.

2.2 EXISTING CONDITIONS

The proposed strategy and borrow area evaluation presented in this report are based on mapping which was developed from aerial photographs taken in 1997 and field surveys performed in Fall 1999; this topography is shown on Figure A-1 in Appendix A. As shown on Figure A-1, the OSDF Borrow Area Sedimentation Basin and previous excavations have disturbed the northwest corner of the EFBA. Excavations have been performed to construct the Sedimentation Basin, borrow excavation for the clay liners for Cells 2 and 3, and the Trap Range stabilization and excavation. This work was performed in accordance with the original BAM&R Plan and initial design documents. There are also stockpiles within the area, including two topsoil stockpiles, clay stockpile 99-4, and reject stockpiles. These stockpiles will be removed before excavation of the subareas on which they are located. These subareas are described in the excavation plan presented in Section 4 of this report.

The OSDF Borrow Area Sedimentation Basin is located in the northwest corner of the EFBA. During development and restoration, the east side of the EFBA will drain through this basin. The bottom of the basin is at Elevation 567 ft, the bottom low level outlet is at Elevation 570 ft, and the primary spillway is at Elevation 575 ft. Because it is a wet basin, the bottom of the basin does not gravity drain below Elevation 570 ft; to avoid pumping and/or excavating wet material, no borrow excavation is proposed below Elevation 570 ft. There are low level outlets (perforations in the pipe riser) between Elevations 570 ft and 575 ft. After rainfall events, the basin will fill to Elevation 575 ft before

activating the principal spillway; therefore, excavation between Elevations 570 ft and 575 ft may be impacted by rainfall. Excavation of the borrow material from these Elevations (570 ft to 575 ft) will increase the capacity of the basin. The basin will provide storage capacity to manage runoff from the disturbed areas of the east side of the EFBA.

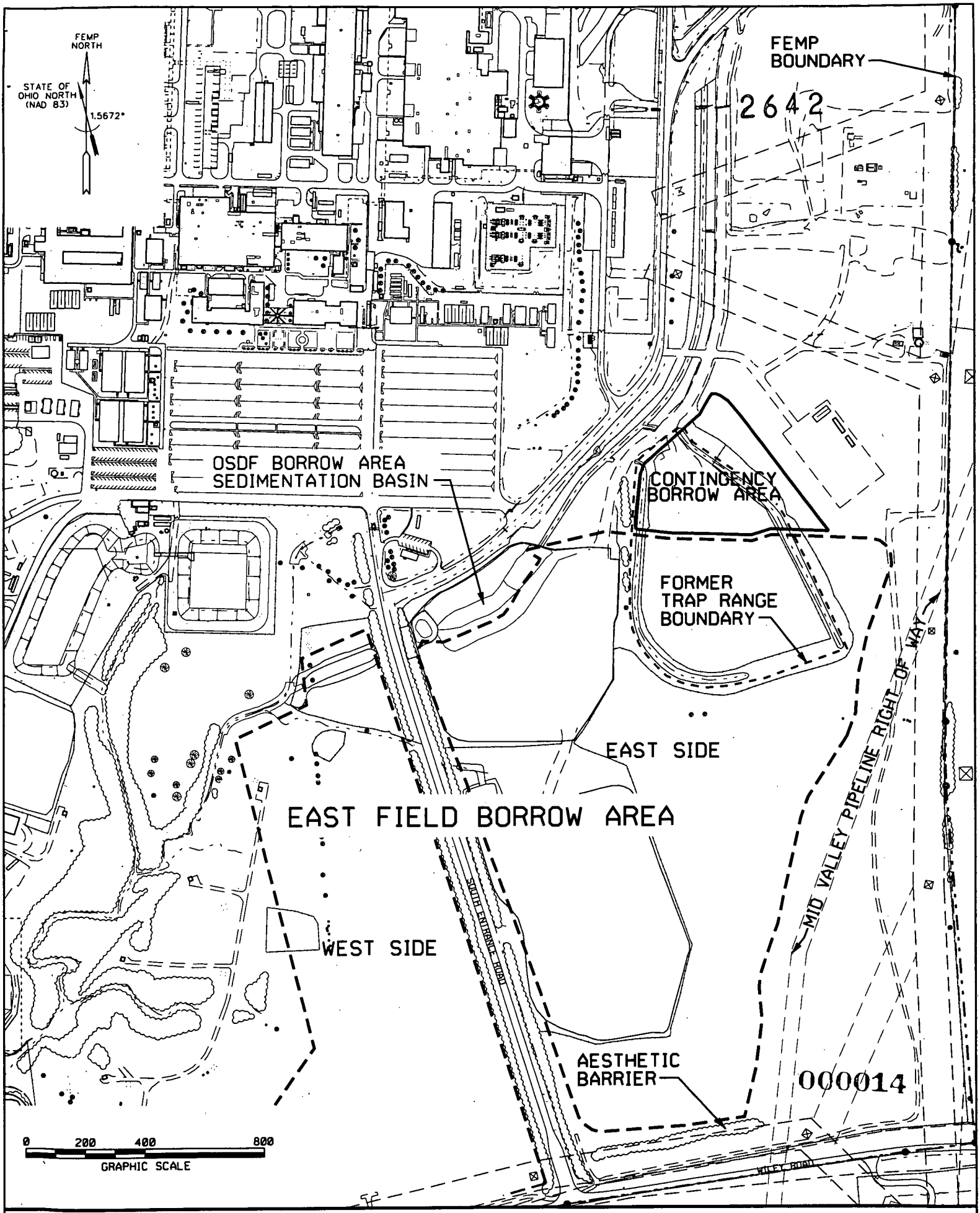

FIGURE 2-1 EAST FIELD BORROW AREA LOCATION MAP

3.0 BORROW MATERIAL REQUIREMENTS

The borrow material quantity estimates are based on obtaining all clay material, ordinary borrow material, and topsoil for future OSDF construction from the east side of the EFBA in Calendar Year 2000 and beyond.

3.1 BORROW MATERIAL REQUIREMENTS

Estimated in-place material quantities for various OSDF earthwork components are summarized on Table 3-1. The calculations for these estimated quantities are presented in Appendix B. The in-place estimated quantities and soil factors presented in this section were used to estimate material quantities to be excavated from the borrow area and to evaluate available borrow volume on the east side of the EFBA.

3.2 SOIL FACTORS

Borrow material that is excavated from the borrow area may not be suitable for OSDF construction. Initial borrow area excavations demonstrated that larger volume of material must be excavated from the borrow area to provide the required quantity of material in the OSDF. Material in the borrow area is measured in bank cubic-yards (bcy); material in the OSDF is measured as in-place cubic yards (icy). The major factors that affect the relationship between the two quantities include:

- Shrinkage/Bulking
- Screener reject
- Unsuitable soil
- Wastage.

The above factors were evaluated based on geotechnical data, OSDF design documents, field data, and field observations. Sources of geotechnical data and design documents are listed in the reference section of this report. Field data and observations include:

- Earthwork and clay liner conformance and performance test results from construction of OSDF Cells 1 and 2;
- Field survey data for stockpiles of screener reject materials, unsuitable soil from the OSDF and borrow area excavations from construction of OSDF Cell 1 and Cell 2;
- Observations of excavation and screening operation during borrow and construction activities for Cells 1, 2, and 3.

Soil factors impacting quantities developed as part of this evaluation are as follows:

- Shrinkage/Bulking Factor: The shrinkage/bulking factor in borrow volume calculations (OSDF Final Design Calculation Package) was based on the Pre-Design Investigation and Site Selection Report for the On-Site Disposal Facility, Revision 0, July 1995, and the Geotechnical Data and Evaluation Report for East and South Field Borrow Areas, Revision 0, June 1996. The shrinkage/bulking factor of 95.5 percent (95.5 bcy in the borrow area will bulk to 100 icy in the OSDF) was estimated in the OSDF Final Design Package.

- Screener Reject Factor: The estimated screener reject factor for clay material is 14 percent; approximately 14 percent of the material that is placed on the screens will be rejected as unsuitable for clay material. Because the clay material screening requirements was added later, screener reject was not considered during the original design. Calculations for the estimated screener reject factor are provided in Appendix B of this report. This factor may be evaluated periodically and adjusted, based on actual conditions encountered in the EFBA.

- Unsuitable Soil Factor: The unsuitable soil factor is estimated to be 12 percent. This is based on the geotechnical investigation reports for the OSDF and EFBA, excavation of OSDF and EFBA during OSDF construction of Cells 1 and 2, and observations in the EFBA during excavation of clay material for the Cell 3 clay liner. Twelve percent is the weighted average of three areas excavated during previous construction seasons. These areas are the Cell 1 and the run-on diversion ditch area; Cells 2 and 3 excavation area; and the north end of the EFBA. This weighted average calculation is provided in Appendix B to this report. Some unsuitable soils, which may be unsuitable for clay material, may be used as ordinary borrow. During the 1999 construction season, higher silt and sand content and lower clay content were observed in the borrow material as the excavation moved from north to south. This trend may be an indication that the quantity of unsuitable material in the southern subareas may increase. This factor will be evaluated periodically, based on conditions encountered in the EFBA.

- Wastage Factor: The wastage factor for borrow volume wasted through spillage, erosion and/or handling from the OSDF excavation and the EFBA is estimated to be 2 percent based on the experience gained from the OSDF Cells 1, 2 and 3 construction. The wastage factor was not considered during the original design. This factor is included volume calculations because of lessons learned in the past three construction seasons.

Table 3-2 presents a summary of the comparison of these soil factors to those in the OSDF Final Design and this evaluation.

3.3 REQUIRED BORROW MATERIAL VOLUMES

The updated soil factors presented on Table 3-2 were used to estimate the required volume of borrow material (bcy) that must be excavated from the borrow area to provide the necessary in-place volumes (icy) presented in Table 3-1. The calculations that were made using these factors are presented in Appendix B. The impacts of these factors are as follows:

- Clay material. Based on the bulking, screener reject, unsuitable soil, and wastage factors, approximately 1.24 bcy of material must be excavated from the borrow area to produce one icy of clay material (liner or cap) in the OSDF. The unsuitable material will be stockpiled and may be used as ordinary borrow. The reject material will be stockpiled within the excavation subarea and used for interim restoration of the subarea.

- Ordinary borrow. Ordinary borrow will consist of material that meets the technical requirements for fill material and can be used as compacted fill for components such as backfill for overexcavation of unsuitable subgrade, compacted fill for berms, vegetative layer, and other miscellaneous fill. To the extent possible, ordinary borrow will be obtained from the OSDF foot print area and supplemented with material from the EFBA. The amount of ordinary borrow that will not be able to be used is expected to by offset by bulking component of the shrinkage/bulking factor; therefore, the factor for this material is estimated to be 1.0.

- Topsoil. Topsoil from the borrow area and the OSDF construction area will be stripped and stockpiled later for use in OSDF cap construction. No significant shrinkage and/or bulking is expected to occur. The estimated wastage factor for this material is 2%. Therefore, approximately 1.02 bcy of topsoil must be excavated to provide 1.0 icy in the OSDF.

The soil factors described above and presented on Table 3-2 were then used to calculate the quantity of material that must be excavated from the borrow area to provide the in-place quantities presented in Table 3-1. The estimated excavation quantities are presented on Table 3-3. As shown on Table 3-3, approximately 902,000 bcy of material are required to be excavated from the borrow area.

The available borrow volume of material in the east side of the EFBA, as shown on Figure A-3 of this report, is approximately 917,000 bcy. This volume is based on excavation to the grades shown on that figure. This available volume exceeds the estimated required material volume of 902,000 bcy presented on Table 3-3. Therefore, there appears to be sufficient volume on the east side of the EFBA to complete construction of seven cells. This conclusion may change if field conditions estimated in the future are significantly different than those outlined in this report.

3.4 CONTINGENCY BORROW

The borrow volume estimates presented in this report are based on soil factors that may change based on conditions encountered in the field. If significantly more unsuitable material is encountered, and/or an additional cell is required, additional borrow material will be required. Therefore, a contingency borrow area is identified to the northeast of the east side of the EFBA, as shown on Figure 2-1.

In addition, the west side of the EFBA will continue to be reserved as a contingency borrow area. This reservation will remain until a few years of excavation on the east side confirm the estimates in this report that indicate there is sufficient material on the east side for OSDF construction requirements.

TABLE 3-1
ESTIMATED IN-PLACE VOLUMES OF BORROW MATERIAL FOR OSDF CONSTRUCTION
(for Calendar Year 2000 and beyond)

	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Totals
1. Backfill for Unsuitable Subgrade	Complete	Complete	Complete	10,000	10,000	10,000	10,000	40,000
2. Compacted Fill	Complete	Complete	Complete	17,000	24,000	15,000	20,000	76,000
3. Miscellaneous Fill	Complete	Complete	Complete	11,000	5,000	5,000	5,000	26,000
4. Clay Liner	Complete	Complete	Complete	37,000	37,000	37,000	37,000	148,000
5. Clay Wedge	Complete	Complete	Complete	4,000	4,000	4,000	8,000	20,000
6. Contouring Layer	12,000	11,000	11,000	11,000	11,000	11,000	12,000	79,000
7. Clay Cap	26,000	24,000	24,000	24,000	24,000	24,000	26,000	172,000
8. Vegetative Cover Soil	36,000	27,000	27,000	27,000	27,000	27,000	36,000	207,000
9. Topsoil	8,000	7,000	7,000	7,000	7,000	7,000	8,000	51,000
Totals	82,000	69,000	69,000	148,000	149,000	140,000	162,000	819,000

Notes:
1) All volumes are in-place cubic yards (icy) as measured in-place in the OSDF.

2) See Appendix B for quantity calculations.

TABLE 3-2
COMPARISON OF ORIGINAL AND UPDATED SOIL FACTORS FOR REQUIRED BORROW VOLUME CALCULATIONS

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Soil Factors	OSDF Final Design	Updated
1. Shrinkage/Bulking Factor	95.5%	95.5%
2. Screener Reject Factor	0	14%
3. Unsuitable Soil Factor	0	12%
4. Wastage Factor	0	2%

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TABLE 3-3
ESTIMATES OF BORROW REQUIRED TO OBTAIN IN-PLACE VOLUMES

OSDF Component	In-Place Volume (icy)	Factor	Borrow Volume (bcy)
1. Backfill for Unsuitable Subgrade (Cells 4-7)	40,000	1.0	40,000
2. Compacted Fill (Cells 4-7)	76,000	1.0	76,000
3. Miscellaneous Fill (Cells 4-7)	26,000	1.0	26,000
4. Clay Liner (Cells 4-7)	148,000	1.24	184,000[1]
5. Clay Wedge (Cells 4-7)	20,000	1.24	25,000[1]
6. Contouring Layer (Cells 1-7)	79,000	1.0	79,000
7. Clay Cap (Cells 1-7)	172,000	1.24	213,000[1]
8. Vegetative Soil Cover (Cells 1-7)	207,000	1.0	207,000
9. Topsoil (Cells 1-7)	51,000	1.02	52,000
TOTALS	819,000		902,000[1]

Note:

1) Material that is unsuitable for the clay material (liner, wedge and cap) may be suitable for ordinary borrow material and topsoil; this unsuitable quantity is estimated to be approximately 41,000 cubic yards. Using this unsuitable material as ordinary borrow material and topsoil will reduce the required borrow volume.

4.0 BORROW AREA EXCAVATION

This section presents the general excavation strategy for the borrow area; it will be further developed in the revised BAM&R in the OSDF Phase III CFC Documents. Implementation details will be presented in the Contractor's Borrow Area Management and Restoration Work Plan.

The borrow area will be developed in accordance with the following general criteria:

- Minimize area disturbed at any one time
- Reach final excavation grade and restore disturbed areas as soon as possible
- Perform interim restoration in an incremental manner
- Manage surface water and provide erosion and sediment controls

In addition to the above, the Contractor will be required to:

- Manage Stockpiles
- Maintain Access

The borrow area will be developed in discrete subareas; excavation in one subarea will be completed before excavation begins in the next subarea. General excavation requirements for development of the borrow area are described in Section 4.1. Excavation scheduling requirements are presented in Section 4.2, and general excavation steps within each subarea are presented in Section 4.3.

4.1 GENERAL EXCAVATION REQUIREMENTS

The general requirements for borrow area development are as follows:

Minimize Area Disturbed at Any One Time. As the OSDF Borrow Area Sedimentation Basin is enlarged through excavation, it will have sufficient capacity to handle runoff from the east side of the EFBA. However, best management practices require that the amount of disturbed area be minimized at all times. Therefore, the size of the area that will be disturbed at one time will be minimized. This will be accomplished by performing interim restoration on each previously disturbed subarea after it has reached final excavation grade before beginning excavation in the next subarea. Other steps that will be used to achieve this objective include: stripping topsoil just prior to beginning excavation in a new subarea, excavating to final grade during one construction season, and performing interim in each subarea after completing excavation during the same construction season.

Reach Final Excavation Grades And Restore Disturbed Areas As Soon As Possible. Excavation will be performed to reach final excavation grade in each subarea in one construction season. Interim restoration will be performed in each subarea as soon as possible after excavation is completed. Once interim restoration is performed, the subarea will not be re-excavated for additional borrow material unless the borrow area needs are changed due to unforeseen conditions.

Manage surface water and provide erosion and sediment controls. Berms, grading, swales and other techniques will be used to divert water around the active excavation subarea in accordance with the BAM&R Plan and technical specifications. Erosion and sediment control measures will be implemented in each borrow subarea. Runoff from disturbed and restored areas will be directed to the OSDF Borrow Area Sedimentation Basin.

Manage Stockpiles. During excavation, the following types of stockpiles will be required to effectively manage the borrow operation:

- Topsoil
- Unsuitable Material
- Reject Material
- Clay Material

Topsoil and unsuitable material will be stockpiled in the area northeast of the borrow area. They will be working stockpiles. Additional material will be added to them as borrow excavation is performed. Material will be removed from them as it is needed for OSDF construction. Topsoil will be stripped from a subarea prior to the start of excavation within that subarea and stockpiled. During excavation for clay material, unsuitable material will be excavated and stockpiled as it is encountered.

Reject material will be stockpiled within the active excavation subarea. At the end of each subarea excavation, reject material will be used for interim restoration of each subarea, as described in Section 5.

Generally, placement of initial clay stockpiles will be on adjacent subareas that are to be excavated in the future. As an active subarea is excavated, clay material stockpiles will be made on the parts of the subarea that are excavated to final grade. Clay material stockpiles within each subarea will be removed prior to interim restoration of that subarea.

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Maintain Access. A haul road from the active borrow area to the OSDF will be used during all phases of OSDF construction. During excavation of the first few subareas, a haul road will be located within the borrow area. During excavation of later subareas, the haul road will be located to the east of the EFBA between the top of excavation and the Mid-Valley Pipeline right-of-way. Relocating the haul road outside of the borrow area will allow the vegetation that will be planted during interim restoration to grow with less disruption. The location of the corridor for this haul road is shown on Figure A-3.

4.2 GENERAL EXCAVATION SCHEDULING REQUIREMENTS

Borrow excavation will be performed to meet OSDF construction requirements. In accordance with the proposed approach, clay material will be excavated, processed, stockpiled and tested by the CQC consultant during the construction season one year before it is scheduled for use in the OSDF. During the following construction season, the stockpiled clay material will be excavated and transported to the OSDF.

Topsoil will be stripped and stockpiled prior to excavation of each subarea; it will then be excavated from the stockpiles as it is required for placement in the OSDF.

Some ordinary borrow material will be generated and stockpiled as clay material is excavated and processed. This material will be excavated from the stockpiles as it is needed. Additional ordinary borrow material may be excavated and hauled directly to the OSDF.

A general borrow area development schedule is presented on Table 4-1. This schedule is based on the preliminary construction schedule as of October 1999. This schedule may change based on funding, impacted material quantities for each year, and other factors. Actual excavation will also be impacted based on field conditions. As shown on Table 4-1, the east side of the EFBA is proposed to be developed in eight subareas; each subarea will be excavated in one construction season. The subarea boundaries are shown on Figure A-5. The limits of each subarea will be refined in the BAM&R Plan and Phase III CFC documents. Actual limits will be determined in the field based on conditions encountered.

4.3 GENERAL EXCAVATION STEPS

The borrow area will be developed in eight subareas. Generally, excavation will proceed as follows:

- Begin initial excavation south of OSDF Borrow Area Sedimentation Basin.
- Continue excavation into the area that was excavated for borrow during the 1999 construction season.
- Move excavation to north end of EFBA, west of the OSDF Borrow Area Sedimentation Basin, and then proceed south
- Excavate to final grade in subareas as borrow excavation is performed
- Perform interim restoration in an incremental manner.

The general construction steps for development of each subarea are as follows:

1. Stake limits for excavation for subarea
2. Install perimeter construction fencing
3. Install appropriate stormwater, erosion and sediment control measures in accordance with the BAM&R Plan and technical specifications
4. Relocate existing stockpiles within the subarea as necessary
5. Strip topsoil
   - Clear and grub as required
   - Stockpile topsoil outside borrow area
   - Construct berm at perimeter
6. Perform grading in the subarea to set up screening plant
7. Set up screening plant
8. Begin berm excavation and screening
9. Excavate unsuitable material and stockpile outside excavation subarea
10. Stockpile screener reject material in excavation subarea or adjacent to excavation subarea
11. Stockpile clay material in adjacent subareas and/or within the current excavation subarea
12. Move screeners within subarea as required
13. Complete screening of material
14. Begin hauling material to cell from active subarea
15. Excavate to final grade to obtain material for ordinary borrow

16. Complete hauling material to cell from subarea; some stockpiles may remain
17. Relocate remaining clay stockpiles from active subarea to adjacent subareas
18. Perform interim restoration within subarea (See Section 5)
19. Continue borrow excavation in next subarea during the next construction season

TABLE 4-1
GENERAL BORROW AREA DEVELOPMENT SCHEDULE

Borrow Area Subarea	Calendar Year	OSDF Phase III Contract	Process and Stockpile Clay – Components and Quantity (icy)	General Scope of Major Borrow Activities
1	2000	NA – OSDF Phase II Contract	L-4 and C-1 (67,000)	Relocate existing stockpiles of topsoil, reject and unsuitable material, Process and stockpile clay material
2	2001	Base	C-2 (24,000)	Haul and place previously stockpiled clay, Process and stockpile clay, Excavate and place ordinary borrow and topsoil
3	2002	Option 1	L-5 and C-3 (65,000)	Haul and place previously stockpiled clay, Process and stockpile clay, Excavate and place ordinary borrow and topsoil
4	2003	Option 2	L-6 and C-4 (65,000)	Haul and place previously stockpiled clay, Process and stockpile clay, Excavate and place ordinary borrow and topsoil
5	2004	Option 3	C-5 (24,000)	Haul and place previously stockpiled clay, Process and stockpile clay, Excavate and place ordinary borrow and topsoil
6	2005	Option 4	C-6 (24,000)	Haul and place previously stockpiled clay, Process and stockpile clay, Excavate and place ordinary borrow and topsoil
7	2006	Option 5	None	Haul and place previously stockpiled clay, Excavate and place ordinary borrow and topsoil
8	After 2006 TBD	NA – Contracting Strategy TBD	L-7 and C-7 (71,000)	TBD

Notes:

1. The general schedule for borrow area development is based on a preliminary construction schedule and may change based on funding and impacted material placement quantities for each construction year.

2. Clay will be processed for clay liner (L) and clay cap (C).

TABLE 4-2
BORROW AREA DEVELOPMENT BY SUBAREA
(quantities in thousands)

-2642

Borrow Area Phase	Calendar Year	Clay Construction Activities		Clay Material		Ordinary Borrow and Topsoil		Total Borrow Excavation (bcy)	Total icy
		Process Clay	Haul and Place Clay	Excavate/ Process/ Stockpile	Place (icy)	Excavate (bcy)	Place (icy)		
1	2000	C-1, L-4	None	83 bcy / 67 icy	0	0	0	83	0
2	2001	C-2	C-1, L-4	30 bcy / 24 icy	67	94	94	124	161
3	2002	L-5, C-3	C-2	81 bcy / 65 icy	24	45	45	126	69
4	2003	L-6, C-4	L-5, C-3	81 bcy / 65 icy	65	84	84	165	149
5	2004	C-5	L-6, C-4	30 bcy / 24 icy	65	75	75	105	140
6	2005	C-6	C-5	30 bcy / 24 icy	24	45	45	75	69
7	2006	None	C-6	0 / 0	24	45	45	45	69
8	After 2006	L-7, C-7	L-7, C-7	88 bcy / 71 icy	71	91	91	179	162
TOTALS				422 bcy / 340 icy	340	479	479	902	819

Notes:

1. The general schedule for borrow area development is based on a preliminary construction schedule and may change based on funding and impacted material placement quantities for each construction year.

2. Clay construction activities include liner (L) and cap (C). Clay liner includes associated intercell berm and wedge.

3. See Tables 3-1 and 3-3 for basis of estimated quantities.

5.0 RESTORATION CONCEPT -- 2642

Restoration will consist of two major steps – interim and final. Interim restoration will be performed within each subarea during each construction season after borrow excavation is completed within that subarea. Borrow excavation will not start in a new subarea until interim restoration is substantially completed in the previously excavated subarea. Final restoration will be performed after borrow excavation and interim restoration are completed in the entire borrow area.

During borrow excavation, the base of each subarea will be generally graded to a flat, gently sloping plane with a 6 horizontal to 1 vertical (6H:1V) outer excavation slope at the borrow area boundary.

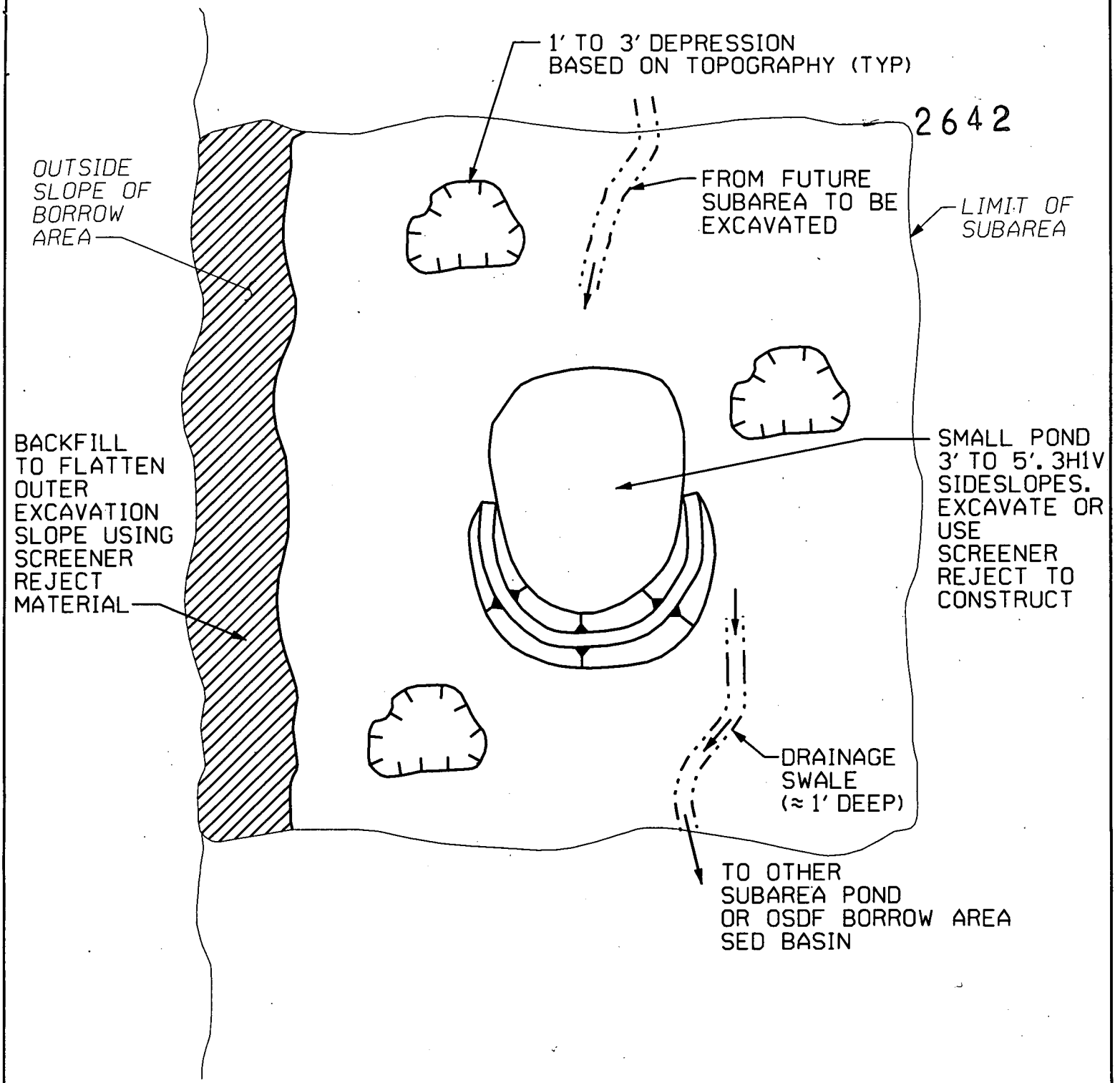
Although interim restoration will very in each subarea, it will typically include grading for construction of a small pond, some depressions, and a drainage swale. The typical interim restoration grading for each subarea is shown on Figure 5-1 and will include the following:

- Spreading screener reject to flatten outer excavation slopes
- Constructing a small pond by excavation and/or dike construction
- Excavating a drainage swale through the subarea
- Excavating small depressions
- Other grading based on subarea-specific conditions

After interim restoration grading is completed, seeding will be performed to establish vegetation, which may consist of a prairie and/or marsh mix. The restored borrow area will be a combination of wet and upland prairie.

Final restoration will consist of planting trees and final vegetation at the perimeter of the borrow area. Only minor regrading will be performed during final restoration.

A conceptual restoration plan for the eight OSDF borrow area subareas is presented on Figure A-6. The exact grading and configuration of each subarea will be determined in the field based on the quantity of reject material that is available for restoration and on actual field conditions. For example, the outer excavation slope of the borrow area will be flattened based on the quantity of material that is available; the slopes may be flattened to 10H:1V if sufficient quantities of reject material are available. The outer excavation slope will be graded to a gently rolling grade to mimic natural conditions as much as possible.



NOTES:

1. SIZE OF FEATURES WILL VARY BASED ON QUANTITIES OF MATERIAL AND TOPOGRAPHY.
2. FILL FOR WATER FEATURES SHALL BE COMPACTED.
3. SEE FIGURE A-6 FOR PLAN TO IMPLEMENT THIS GRADING WITHIN THE OSDF BORROW AREA.

000030

FIGURE 5-1
TYPICAL INTERIM RESTORATION GRADING

NTS

figures.dgn

REFERENCES

=2642

U.S. Department of Energy, November 1997, "On-Site Disposal Facility - Phase II, Certified-for-Construction," Revision 0, DOE, Fernald Environmental Project, Cincinnati, OH

U.S. Department of Energy, May 1997, "OSDF Design Criteria Package," Revision 0, DOE, Fernald Environmental Management Project, Cincinnati, OH.

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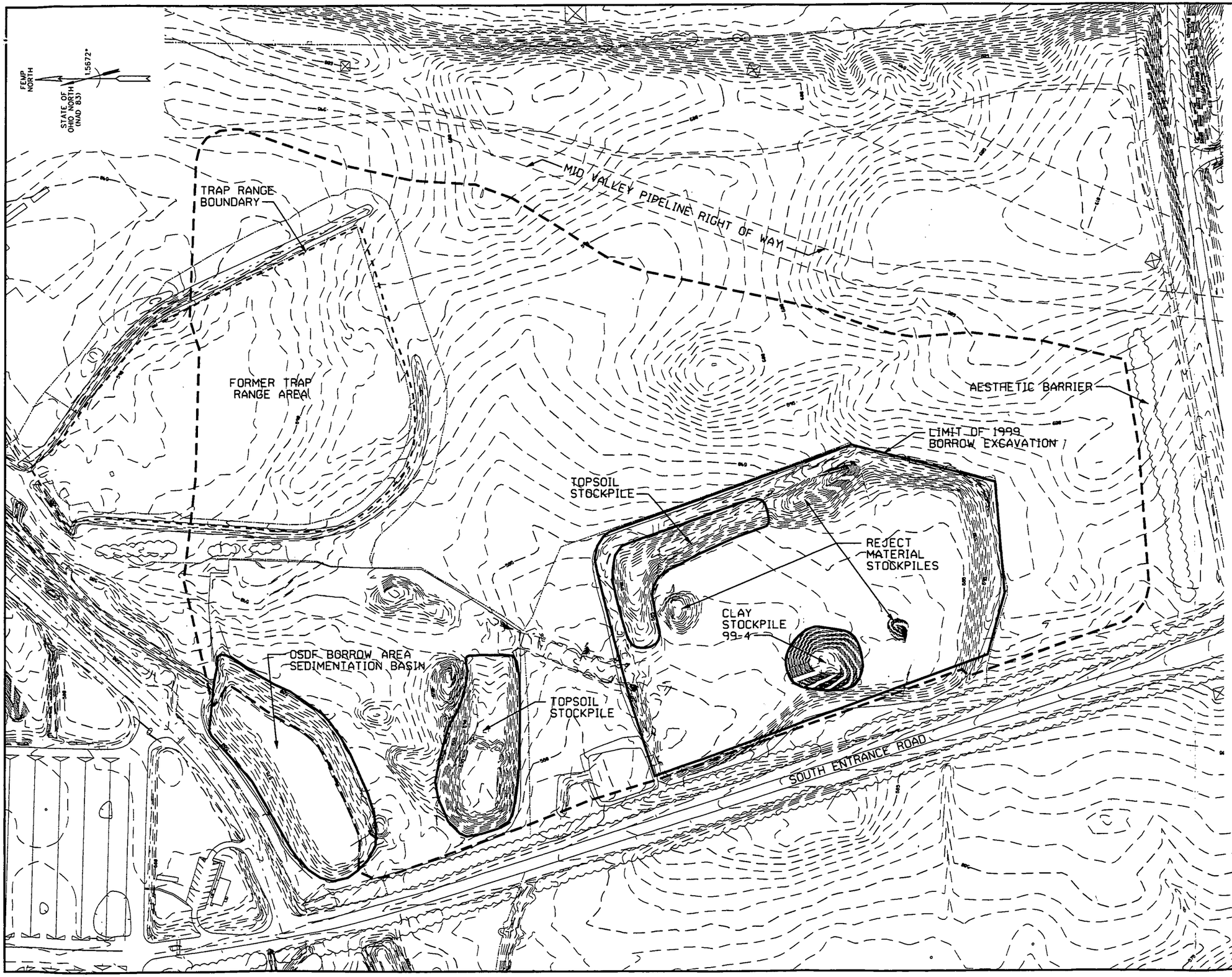
U.S. Department of Energy, November 1996, "On-Site Disposal Facility - Phase I Construction Package, Certified-for-Construction," Revision 0, DOE, Fernald Environmental Project, Cincinnati, OH.

U.S. Department of Energy, June 1996, "Geotechnical Data and Evaluation Report for East and South Field Borrow Areas," Revision 0, DOE, Fernald Environmental Management Project, Cincinnati, OH.

U.S. Department of Energy, July 1995, "Pre-Design Investigation and Site Selection Report for the On-Site Disposal Facility," Revision 0, DOE, Fernald Environmental Management Project, Cincinnati, OH.

APPENDIX A

BORROW AREA FIGURES



NOTES:

① EXISTING SURFACE CONTOURS FROM AERIAL PHOTOGRAPHY FLOWN APRIL, 1997. AREAS WITHIN BORROW AREA UPGRADED BASED ON FIELD SURVEYS PERFORMED IN SEPTEMBER AND NOVEMBER 1999.

2642

LEGEND:

- — — — LIMIT OF BORROW AREA
- — — — EXISTING SURFACE CONTOURS

0 50 100 200 400

GRAPHIC SCALE

ON-SITE DISPOSAL FACILTIY
FIGURE A-1
EAST FIELD BORROW AREA
EXISTING CONDITIONS PLAN

000033

DATE: 11/29/99

REV: A

fig01.dgn

FEMP NORTH

1.5672°

STATE OF OHIO NORTH (NAD 83)

NOTES:

1. EXISTING SURFACE CONTOURS FROM AERIAL PHOTOGRAPHY FLOWN APRIL, 1997. AREAS WITHIN BORROW AREA UPGRADED BASED ON FIELD SURVEYS PERFORMED IN SEPTEMBER AND NOVEMBER 1999.
2. VOLUME OF MATERIAL WITHIN LIMIT OF BORROW AREA EXCAVATION IS APPROXIMATELY 917,000 CY.

--2642

HAUL ROAD CORRIDOR

600
595
590
585
580

TOPSOIL AND UNSUITABLE MATERIAL STOCKPILE AREA

0.25%

577

576

1.25%

0.25%

575

574

1.25%

573

572

SOUTH ENTRANCE ROAD

6 HORIZONTAL: 1 VERTICAL OUTER EXCAVATION SLOPE (TYP.)

LEGEND:

- LIMIT OF BORROW AREA
- EXISTING SURFACE CONTOURS
- BORROW AREA EXCAVATION CONTOURS

0 50 100 200 400

GRAPHIC SCALE

ON-SITE DISPOSAL FACILTIY
FIGURE A-3
EAST FIELD BORROW AREA
EXCAVATION GRADING PLAN
000034

DATE: 11/29/99

REV: A

fige3.dgn

NOTES:

1. EXISTING SURFACE CONTOURS FROM AERIAL PHOTOGRAPHY FLOWN APRIL, 1997. AREAS WITHIN BORROW AREA UPGRADED BASED ON FIELD SURVEYS PERFORMED IN SEPTEMBER AND NOVEMBER 1999.
2. TOP OF GRAY TILL CONTOURS AND GRAY TILL ISOPACHS OBTAINED FROM FIGURES 3-3 AND 3-4 OF THE "PREDESIGN INVESTIGATION AND SITE SELECTION REPORT FOR THE ON-SITE DISPOSAL FACILITY, FERNALD ENVIRONMENTAL MANAGEMENT PROJECT", U.S. DEPARTMENT OF ENERGY, JULY 1995.

2642

LEGEND:

- LIMIT OF BORROW AREA
- EXISTING SURFACE CONTOURS
- CONTOURS OF BROWN TILL/GRAY TILL INTERFACE (TOP OF GRAY TILL)
- (12) GRAY TILL ISOPACH (THICKNESS OF GRAY TILL)

0 50 100 200 400
GRAPHIC SCALE

ON-SITE DISPOSAL FACILTIY
FIGURE A-2
EAST FIELD BORROW AREA
TOP OF GRAY TILL AND
GRAY TILL ISOPACHS

000035

DATE: 11/29/99 REV: A
fig2.dgn

NOTES:

1. EXISTING SURFACE CONTOURS FROM AERIAL PHOTOGRAPHY FLOWN APRIL, 1997. AREAS WITHIN BORROW AREA UPGRADED BASED ON FIELD SURVEYS PERFORMED IN SEPTEMBER AND NOVEMBER 1999.
2. DEPTH OF EXCAVATION INTO GRAY TILL AND DEPTH OF GRAY TILL REMAINING BASED ON INFORMATION PRESENTED ON FIGURES 3-3 AND 3-4 OF THE "PREDESIGN INVESTIGATION AND SITE SELECTION REPORT FOR THE ON-SITE DISPOSAL FACILITY, FERNALD ENVIRONMENTAL MANAGEMENT PROJECT", U.S. DEPARTMENT OF ENERGY, JULY 1995.

2642

LEGEND:

- LIMIT OF BORROW AREA
- EXISTING SURFACE CONTOURS
- BORROW AREA EXCAVATION CONTOURS
- AREAS WHERE BORROW EXCAVATION EXTENDS INTO GRAY TILL
- 6/14 DEPTH OF EXCAVATION INTO GRAY TILL/DEPTH OF REMAINING GRAY TILL

0 50 100 200 400
GRAPHIC SCALE

ON-SITE DISPOSAL FACILTIY
FIGURE A-4
EAST FIELD BORROW AREA GRADING PLAN WITH GRAY TILL EXCAVATION INFORMATION

DATE: 11/29/99

000036

REV: A

fig04.dgn

FEMP NORTH

STATE OF OHIO NORTH (NAD 83) 1.5672°

NOTES:

1. EXISTING SURFACE CONTOURS FROM AERIAL PHOTOGRAPHY FLOWN APRIL, 1997. AREAS WITHIN BORROW AREA UPGRADED BASED ON FIELD SURVEYS PERFORMED IN SEPTEMBER AND NOVEMBER 1999.
2. VOLUME OF MATERIAL WITHIN LIMIT OF BORROW AREA EXCAVATION IS APPROXIMATELY 917,000 CY.
3. BOUNDARIES BETWEEN SUBAREAS WILL VARY BASED ON SIDE SLOPES, ACTUAL FIELD CONDITIONS, AND CONSTRUCTION SCHEDULE.
4. SUBAREAS FOR EXCAVATION BASED ON PRELIMINARY CONSTRUCTION SCHEDULE AND MAY CHANGE BASED ON FUNDING, AND ACTUAL IMPACTED MATERIAL PLACEMENT QUANTITIES.

2642

SUBAREA	APPROX. VOLUME (BCY)
1	105,000
2	120,000
3	120,000
4	165,000
5	105,000
6	72,000
7	45,000
8	185,000
TOTAL	917,000

TOPSOIL AND UNSUITABLE MATERIAL STOCKPILE AREA

600
595
590
585
580
577
576
575
574
573
572

1.25%
0.25%
0.25%
1.25%

SOUTH ENTRANCE ROAD

LEGEND:

- LIMIT OF BORROW AREA
- EXISTING SURFACE CONTOURS
- BORROW AREA EXCAVATION CONTOURS
- SUBAREA BOUNDARY

0 50 100 200 400
GRAPHIC SCALE

ON-SITE DISPOSAL FACILTIY
FIGURE A-5
BORROW AREA EXCAVATION SUBAREAS

000037

DATE: 11/29/99

REV: A

fig05.dgn

FEMP NORTH

1.5672°

STATE OF OHIO NORTH (NAD 83)

NOTES:

1. DETAILS REGARDING SMALL POND CONSTUCTION, FLATTENING OUTSIDE SLOPE AND OTHER RESTORATION GRADING WILL VARY DEPENDING ON ACTUAL QUANTITIES OF REJECT MATERIAL AVAILABLE WITHIN THE SUBAREA.
2. EXISTING CONTOURS WITHIN LIMIT OF BORROW AREA NOT SHOWN FOR CLARITY.

2642

BACKFILL TO FLATTEN OUTSIDE SLOPE

TOPSOIL AND UNSUITABLE MATERIAL STOCKPILE AREA

OSDF BORROW AREA SEDIMENTATION BASIN

SOUTH ENTRANCE ROAD

600
595
590
585
580
577
576
575
573
572

LEGEND:

- LIMIT OF BORROW AREA
- SUBAREA BOUNDARY
- DEPRESSION (TYP)
- (8) SUBAREA DESIGNATION
- GENERAL FLOW DIRECTION
- SMALL POND
- OUTSIDE SLOPE TO BE FLATTENED WITH REJECT MATERIAL
- SWALE
- EXISTING SURFACE CONTOURS
- BORROW AREA EXCAVATION CONTOURS

0 50 100 200 400

GRAPHIC SCALE

ON-SITE DISPOSAL FACILTIY
FIGURE A-6
CONCEPTUAL BORROW AREA
RESTORATION PLAN

000038

DATE: 11/29/99

REV: A

fig6.dgn

APPENDIX B

CALCULATIONS

FERNALD
ENVIRONMENTAL RESTORATION MANAGEMENT CORPORATION -- 2642

ENGINEERING CALCULATION

PROJECT NUMBER:	
BY: A.P. KLIMEK	DATE: 11/14/99
CHECKED BY:	DATE:
PAGE 1 OF 4	
SUBJECT:	REVISED:

ESTIMATE QUANTITIES OF BORROW FOR OSDF

1. BACKFILL FOR UNSUITABLE SUBGRADE OVER EXCAVATION

ESTIMATE ONLY - ASSUME 10,000 ICY PER CELL.
CONSERVATIVE - VERY LITTLE IN CELLS 1, 2 AND 3.

2. COMPACTED FILL

COMPACTED FILL WILL BE REQUIRED TO CONSTRUCT SIDE BERMS AT OSDF. IT WILL VARY FROM CELL TO CELL. MATERIAL WAS OBTAINED FROM OSDF FOOTPRINT AREA FOR CELLS 1, 2 AND 3. SEE SUMMARY SHT (3 OF 4) FOR OSDF CALCS. ASSUME ALL MATERIAL WILL NEED TO COME FROM BORROW AREA:

- CELL 4 - 17,000 ICY
- CELL 5 - 24,000 ICY
- CELL 6 - 15,000 ICY
- CELL 7 - 20,000 ICY - (USE ESTIMATE FOR LAST CELL)

3. MISCELLANEOUS FILL

ESTIMATE ONLY - ASSUME 5000 ICY FOR EACH CELL EXCEPT CELL 4: ADD 6000 ICY TO BACKFILL PART OF SEDIMENT BASIN FOR PERMANENT LCS AS PART OF CELL 4

4. CLAY LINER

SEE ATTACHED SUMMARY SHT (SHEET 3 OF 4)
USE 37,000 ICY / CELL (INCLUDES INTER CELL BERM)

5. CLAY WEDGE

SEE ATTACHED CALCULATION SHEET (SHEET 4 OF 4)
USE 4000 ICY (4 to 6) USE 8,000 ICY FOR CELL 7

000040

6. CONTOURING LAYER

SEE ATTACHED SUMMARY SHT (SHEET 3 OF 4)
USE 11,000 ICY FOR CELLS 2 to 6, ADD 1000 ICY FOR FIRST (CELL 1) AND LAST CELL - 12,000 ICY

FERNALD
ENVIRONMENTAL RESTORATION
MANAGEMENT CORPORATION

=-2642

ENGINEERING CALCULATION

PROJECT NUMBER:	
BY: A P. KUMIK	DATE: 11/14/99
CHECKED BY:	DATE:
PAGE 2 OF 4	
SUBJECT:	REVISED:

7. COMPACTED CLAY CAP

SEE ATTACHED SUMMARY SHT (SHT 3 OF 4)

USE 26,000 ICY FOR FIRST AND LAST CELL (1 AND 7)

USE 24,000 ICY FOR OTHER CELLS (2 TO 6)

8. VEGETATIVE SOIL COVER

SEE ATTACHED SUMMARY SHT (SHT 3 OF 4)

USE 36,000 ICY FOR FIRST AND LAST CELL (1 AND 7)

USE 27,000 ICY FOR OTHER CELLS (2 TO 6)

9. TOPSOIL

SEE ATTACHED SUMMARY SHT (SHT 3 OF 4)

USE 8000 ICY FOR FIRST AND LAST CELL (1 AND 7)

USE 7000 ICY FOR OTHER CELLS (2 TO 6)

000041

Paul J. Sabatini

#4 #7 #8 #9 #2 #6

TABLE 2. SUMMARY OF REQUIRED EARTHWORK QUANTITIES

Cell No.	Compacted Clay Liner (cy)	LDS Drainage Layer (cy)	LCS Drainage Layer (cy)	Protective Soil Layer (impacted) (cy)	Protective Soil Layer (non-impacted) (cy)	Compacted Clay Cap (cy)	Cover Drainage Layer (cy)	Biointrusion Barrier (cy)	Choke Layer (cy)	Granular Filter (cy)	Vegetative Soil Layer (cy)	Topsoil (cy)	Seasonal Cover (cy)	Compacted Fill (cy)	(adjusting) LAYER (cy)
1	41,900	11,500	14,109	7,692	1,201	26,179	18,922	39,881	3,171	8,467	36,358	8,467	3,593	16,246	11,207
2	36,866	10,697	13,306	6,889	1,201	23,704	14,371	35,689	2,907	6,749	26,575	6,749	3,593	6,254	10,874
3	36,866	10,697	13,306	6,889	1,201	23,704	14,371	35,689	2,907	6,749	26,575	6,749	3,593	14,755	10,874
4	36,866	10,697	13,306	6,889	1,201	23,704	14,371	35,689	2,907	6,749	26,575	6,749	3,593	16,847	10,874
5	36,866	10,697	13,306	6,889	1,201	23,704	14,371	35,689	2,907	6,749	26,575	6,749	3,593	23,882	10,874
6	36,866	10,697	13,306	6,889	1,201	23,704	14,371	35,689	2,907	6,749	26,575	6,749	3,593	15,244	10,874
7	36,866	10,697	13,306	6,889	1,201	23,704	14,371	35,689	2,907	6,749	26,575	6,749	3,593	11,264	10,874
8	34,135	9,907	12,357	7,459	-	26,179	18,922	39,881	3,171	8,467	36,358	8,467	-	19,945	11,207
TOTAL	297,231	85,589	106,302	56,485	8,407	194,582	124,070	293,896	23,784	57,428	232,166	57,428	25,151	124,437	87,658
TOTAL (9 cells)	334,097	96,286	119,608	63,374	9,608	218,286	138,441	329,585	26,691	64,177	258,741	64,177	28,744	137,071	98,532

Total riprap = 26,574 cy

ALL QUANTITIES IN ICY (WITHIN OSDF) APK - 11/30/99

QUANT.XLS

CELL 8 QUANTITIES USED FOR CELL 7 IN BASR APK - 11/30/99

REF: FROM VOLUME I OF OSDF FINAL CALCULATION PACKAGE BY GEOSYNTEC MAY 97, REV 0, APP H.

APK 11/19/99 page 2 of 32

DD DGP 2 NOV 96 FDS 3 OCT 96 = 2642

2:53 PM

3/4

000042

(c) DEVELOP CROSS SECTIONS FOR CELL 2-3 INTERCELL BERM USING GIVEN CONTROL POINTS.

SEE ATTACHED FOR CROSS SECTIONS.

VOLUME OF BERM =

AVG OF END AREAS * LENGTH OF BERM (PLANIMETERED)

LENGTH OF BERM = 675'

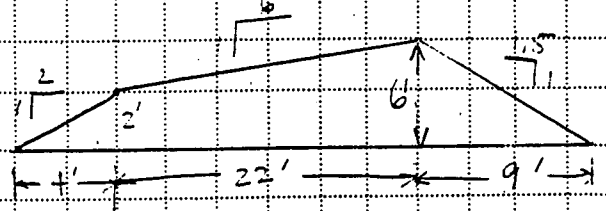
VOL = $\frac{27.49 + 81.60}{2}$ in² $\left(\frac{10^2}{\quad}\right)\left(\frac{\quad}{\quad}\right)\left(\frac{CY}{27^3}\right)$ = 7386 CY

#5

(d) DETERMINE VOLUME OF WEDGE FROM DIMENSIONS SCALED FROM PHASE II DWG

LENGTH OF BERM = 420'

OF BERMS = 2



AREA = 4 sf + 88 sf + 27 sf = 119 sf

VOL = 119 sf (430 ft)(2) / 27 ft³/cy = 3790 cy

SAY 4,000 ICY APK 11/3/99

USE DOUBLE OR 8,000 ICY FOR CELL 7

(e) Total Clay Vol. =

$\frac{234,550 \text{ sf}\,(3')}{27} - \frac{12,135 \text{ sf}\,(1.5')}{27} + 7386 \text{ cy} + 3790 \text{ cy}$

41,902 cy

000043

FERNALD
ENVIRONMENTAL RESTORATION
MANAGEMENT CORPORATION

2642

ENGINEERING CALCULATION

PROJECT NUMBER: 20100	
BY: A.P. KLIMEK	DATE: 11/16/99
CHECKED BY:	DATE:
PAGE 1 OF 7	
REVISED:	

SUBJECT:

ESTIMATE SOIL FACTORS FOR BORROW MATERIAL.

1. SOIL SWELL FACTOR. USE 0.955 AS PRESENTED IN OSOF FINAL DESIGN CALCULATIONS SEE SHT 3 OF 7, ATTACHED. (FROM FINAL DESIGN CALCS) ✓

2. SCREENED REJECT FACTOR.
USE 14%, SEE ATTACHED SHTS 4, 5 AND 6
14% IS REASONABLE BASED ON CELL 3 EXPERIENCE

3. UNSUITABLE SOIL FACTOR
USE 12% SEE ATTACHED SHT 7 OF 7
12% IS REASONABLE BASED ON CELL 3 EXPERIENCE

4. WASTAGE FACTOR - USE 2% (ESTIMATE - NO CALCS)

000044

BY: RICK HEATH

-- 2642

CUMULATIVE SOIL FACTORS

CHECKED/REVISED: A.P.KLMEK 11/16/99

Find - Cumulative soil factors needed to convert from compacted in-place cubic yards to bank cubic yards to be borrowed

Given - Soil factors for clay compaction and OSDF Final Design Calculation Package Vol IV

1.0 ICY compacted glacial till = 0.955 BCY Borrow Soil (SHT 3 OF 7)

1.14 BCY unscreened borrow soil = 1.0 BCY screened soil (SHTS 4, 5 AND 6)

1.12 BCY total borrow soil = 1.0 BCY suitable borrow soil (SHT 7 OF 7)

1.02 BCY total borrow soil = 1.0 BCY delivered to cell (ESTIMATE ONLY, NO CALCS)

Find - Compacted Clay Liner (CCL) cumulative factor

$$\frac{\text{1 ICY Compacted Clay Liner}}{\text{1 ICY CCL}} * \frac{\text{0.955 BCY Borrow}}{\text{1ICY CCL}} * \frac{\text{1.14 BCY unscreened}}{\text{1 BCY screened}} *$$

$$\frac{\text{1.12 BCY unsuitable}}{\text{1 BCY suitable}} * \frac{\text{1.02 BCY total}}{\text{1 BCY delivered}} = \frac{\text{1.244 BCY Borrow}}{\text{1 ICY CCL}}$$

USE 1.24 APK

Find - ORDINARY BORROW ~~Compacted Fill~~ APK cumulative factor

$$\frac{\text{1 ICY Compacted Fill}}{\text{1 ICY Compacted Fill}} * \frac{\text{0.955 BCY Borrow}}{\text{1BCY Delivered}} * \frac{\text{1.03 APK ~~1.12~~ BCY unsuitable}}{\text{1 BCY suitable}} *$$

$$\frac{\text{1.02 BCY total}}{\text{1 BCY delivered}} = \frac{\text{1.003 ~~1.09~~ BCY Total Borrow}}{\text{1 ICY Compacted Fill}}$$

ASSUME THAT ONLY 1/4 OF MATERIAL THAT IS UNSUITABLE FOR CLAY LINER WILL BE UNSUITABLE FOR ORDINARY BORROW. APK 11/16/99

USE 1.00 APK 11/16/99

Written By: PJP Date: 21 Feb 1996 Reviewed by: PJS Date: 96-2-22

Client: FERMCO Project: FERNALD OSDF Project/Proposal No.: GE3900 Task No.: 8.11

contingency volume is provided for the following reasons: (i) construction of a ninth OSDF contingency cell if disposal volumes are larger than anticipated; (ii) to backfill to subgrade elevations beneath the footprint of the OSDF in the event that additional excavation of impacted material is necessary; and (iii) if insufficient volumes of suitable impacted material are available to complete the construction of a component of the liner or cover system.

CONCLUSIONS

* → The shrinkage/bulk factor for the brown till is calculated to be 0.955 (i.e., 0.955 ft^3 of in situ brown till material is required to construct 1.000 ft^3 of compacted material). This implies the bank/unbulked brown till will undergo a net increase in volume of approximately 4.7 percent once compacted in-place as part of the OSDF liner/cover system.

The required bank/unbulked volume was calculated to be 433,567 yd^3 for the Borrow Area. There is 590,834 yd^3 of material available in the Borrow Area, an excess of 157,267 yd^3 of material for use in constructing specific earthwork components of the OSDF. This excess corresponds to a 19.5% contingency volume; this exceeds the minimum required contingency of ~~10%~~.

17.5% ✓ (KO)

ΔD, DGP
2 APRIL 96

REF/SOURCE: "FINAL DESIGN CALCULATION PACKAGE, OSDF VOL IV OF IV", BY GEOSYNTEC, MAY 1997

APK
11/16/99

FERNALD ENVIRONMENTAL RESTORATION MANAGEMENT CORPORATION -- 2642

ENGINEERING CALCULATION

PROJECT NUMBER:	
BY: Y. AFSHAR	DATE: 12/14/98
CHECKED BY: REH	DATE: 12/29/98
PAGE 1 OF 2	
REVISED: DARKENED APK 11/16/99	
CLARIFIED APK 11/16/99	

SUBJECT: Clay Screening Reject Factor

CALCULATE REJECT FACTOR (%) FOR BORROW MATERIAL FOR CONSTRUCTION OF THE OSDF.

GIVEN:

- CLAY VOL REQUIRED FOR EACH CELL = 39,426 (ICY) x 0.955 = 37,652 BCY ✓

SOURCES OF CLAY USED FOR CONSTRUCTION OF CELL 2 :

1. CELL FOOT PRINT
   BANK VOLUME = 32,810 BCY

2. EAST BORROW AREA : (EFBA)
   VOLUME OF REJECT MATERIAL = 2055 CY

APK 11/16/99 VOL. OF REJECT FROM FOOT PRINT AREA - UNKNOWN
VOL. OF BORROW FROM EFBA - UNKNOWN

SOLUTION :

(VOL FROM CELL FOOT PRINT - REJEC) +

(VOL FROM EAST BORROW AREA - REJECT) = 37,652 BCY

ASSUMING REJECTION FACTOR = X%
VOLUM FROM EAST BORROW AREA = y

∴ REJECT FROM EAST BORROW AREA = Xy = 2055 CY
ASSUMING A 20% BULKING FACTOR
$Xy = (0.8)(2055) = 1644$ BCY $\quad y = \frac{1644}{X}$ ---I

$(32,810 - 32,810X) + (y - Xy) = 37,652$ ---II

000047

$(32,810 - 32,810X) + \left(\frac{1644}{X} - \frac{1644}{X}X\right) = 37,652$

FERNALD
ENVIRONMENTAL RESTORATION
MANAGEMENT CORPORATION

-2642

ENGINEERING CALCULATION

PROJECT NUMBER:	
BY: Y. AFSHAR	DATE: 12/10/98
CHECKED BY: REH	DATE: 2/29/98
PAGE 2	OF 2
REVISED: DARKENED 11/16/99	

SUBJECT:

$$-\frac{32810}{+} - \frac{32810X}{+} + \frac{1644}{X} - \frac{1644}{+} - \frac{37652}{+} = 0$$

$$X\left(32810X - \frac{1644}{X} + 6496\right) = 0 \quad (x)$$

$$\underset{a}{32810}X^2 + \underset{b}{6486}X - \underset{c}{1644} = 0$$

$$X = \frac{-b \pm \sqrt{(b^2) + 4ac}}{2a} \qquad (\text{QUADRATIC EQUATION})$$

$$X = \frac{-6486 \pm \sqrt{(6486)^2 - 4(32810)(-1644)}}{2(32810)}$$

$$X = \frac{-6486 \pm 16057}{65620}$$

$$X = \frac{9,571}{65620} = 0.145 \simeq 14\% \Leftarrow$$

DARKENED BY
APK 11/16/99

000048

BY: R. HEATH

CHECK OF REJECT FACTOR CALCULATION

ALL VOLUMES IN BANK CUBIC YARDS

$= -2642$

Y 1541 X

TOTAL INTO CELL 2	BORROW FROM FP	FR BORROW - REJECT	EFBA INTO CELL2	EFBA SPOIL	REJECT FACTOR
37652	32810	30185.200	7466.800	645.132	0.080
37652	32810	29529.000	8123.000	893.530	0.100
37652	32810	28872.800	8779.200	1179.924	0.120
37652	32810	28216.600	9435.400	1505.890	0.140
37652	32810	28183.790	9468.210	1523.255	0.141
37652	32810	28150.980	9501.020	1540.723	0.142

THIS WAS AN INDEPENDENT CHECK ASSUMING BCY REJECT OF 1541 CY

APK 11/17/99

=-2642

BY: RICK HEATH

UNSUITABLE SOIL FACTORS

CHECKED
REVISED: A.P. KLIMEK 11/16/99

Find - Percent of soil excavated from OSDF footprint and EFBA that is not suitable for use as clay liner.

Method - From Cell 1 & 2 liner construction experience estimate quantity of soil rejected or diverted to other purposes beside compacted clay liner.

(1) North and West ditch and Cell 1 excavation was 14' deep
Gray till intermixed with sand seam = 4' thick over bottom 60% of excavation

$\frac{4}{14} * 0.6 = 17.1\%$ unsuitable ✓

(2) Cell 2 & 3 excavation was ≈ 7' deep
Silts and sands comprised ≈ ½' thick over 1/3 of excavation

$\frac{0.5'}{7'} * 0.3 = 2.1\%$ unsuitable ✓

(3) Borrow area east of SER was 95% suitable, 5% unsuitable -
Borrow area west of SER was 10% suitable, 90% unsuitable -

APK
EAST ~~West~~ side volume was ≈ 55,000 BCY E
APK
WEST ~~East~~ side volume was ≈ 9,000 BCY E

$$\frac{W \quad W \quad E \quad E}{\frac{0.90 * 9{,}000 + 0.05 * 55{,}000}{64{,}000}} = 16.9\% \text{ unsuitable}$$

APK 11/16/99
SER - SOUTH ENTRANCE ROAD. EXCAVATION WAS FOR OSDF BORROW AREA SED. BASIN (EAST OF SER) AND OUTFALL DITCH (WEST OF SER). MOST OF MATERIAL ON WEST SIDE WAS UNSUITABLE

Each area contained approximately the same borrow volume

Average unsuitable soil from the 3 areas = 17.1 + 2.1 + 16.9) /3 = 12.1% ✓

Say 12% unsuitable for each BCY excavated

This factor will change as new borrow areas are excavated and more information becomes available.

12% UNSUITABLE IS REASONABLE BASED ON CELL 3 EXCAVATION IN BORROW AREA